US Patent Application Number: 09/888,668
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

On behalf of

Meng **YAO**

APPELLANT

Application: **09/888,668** Examiner: **P. Huntsinger**

Filed: **June 25, 2001** Group Art Unit: **2625**

Confirmation: **8867**

Title: **STOCHASTIC HALFTONE SCREENING METHOD**

APPELLANT'S BRIEF ON APPEAL

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APPLICANT: Meng **YAO** **GROUP**: 2625

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FOR: STOCHASTIC HALFTONE SCREENING METHOD

Commissioner for Patents
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APPEAL BRIEF FOR APPELLANTS

This Appeal Brief is being submitted in accordance with the Notice of Appeal filed on January 3, 2007 in connection with the above-identified application.

I. REAL PARTY OF INTEREST

The party of real interest to this appeal is the Assignee, Xerox Corporation.

II. RELATED APPEALS AND INTERFERENCES

The Appellant knows of no other pending appeals or interferences that are related to this instant appeal.

III. STATUS OF CLAIMS

Claims 1-15 have been previously presented in this application. Claims 1-15 are appealed.

IV. STATUS OF AMENDMENTS

The Appellant submitted a Response under 37 C.F.R. 1.116 on November 7, 2006. The Appellant submitted a Supplemental Response under 37 C.F.R. 1.116 on December 12, 2006. The Appellants have not filed any other Responses and/or Amendments subsequent to the Final Office Action, dated October 10, 2006.

V. SUMMARY OF CLAIMED SUBJECT MATTER

In accordance with 37 C.F.R. 41.37(2)(c)(v), the following are concise explanations of the subject matter defined in the independent claims (1, 6, and 9) involved in this Appeal.

A. Independent Claim 1

Independent claim 1 recites a halftone processor (see, for example, item 16 of Figure 1 and paragraph **[0019]** of the published patent application) for converting a gray scale image comprising a plurality of m-bit pixels to a halftoned image comprising a plurality of n-bit pixel images, where m > n. The processor includes a memory (see, for example, item 30 of Figure 2 and paragraph **[0022]** of the published patent application) storing a stochastic screen, the stochastic mask being a stochastic screen constrained by a checkerboard pattern (see, for example, paragraph **[0023]** of the published patent application), the checkerboard pattern constrained stochastic screen comprising a set of threshold values, each threshold value in the checkerboard pattern constrained stochastic screen corresponding to a gray level, each threshold value corresponding to a gray level between a first gray level (g_{s1}) and a second gray level (g_{s2}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a black pixel position in the checkerboard pattern (see, for example, paragraph **[0036]** of the published patent application), each threshold value corresponding to a gray level between the second gray level (g_{s2}) and a third gray level (g_{s3}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a white pixel position in the checkerboard pattern (see, for example, paragraph **[0039]** of the published patent application), the first gray level (g_{s1}) being greater than the second gray level (g_{s2}), the second gray level (g_{s2}) being greater than the third gray level (g_{s3}), the third gray level (g_{s3}) corresponding to a black dither of 50% or less for gray levels (g_s) wherein $x < g_s < y$, x corresponding to 100% black, y corresponding to 0% black; and a comparator (see, for example, item 32 of Figure 2 and paragraph **[0022]** of the published patent application) receiving the gray scale image and the set of threshold values corresponding to the checkerboard pattern constrained stochastic screen, the comparator comparing, on a pixel-by-pixel basis, a

value of each pixel in the gray scale image to a corresponding threshold value in the checkerboard pattern constrained stochastic screen to produce the halftoned image.

B. Independent Claim 6

Independent claim 6 recites a method of generating a halftone screen for converting an image received at d levels, for reproduction at c levels, where d > c, the method, in optional sequence. The method generates a first initial stochastic screen pattern for a first gray level, the initial stochastic screen pattern being constrained by a checkerboard pattern such that a black pixel in the first initial checkerboard pattern constrained stochastic screen pattern is positioned in the first initial checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern; generates a plurality of subsequent first checkerboard pattern constrained stochastic screen patterns, each subsequent first checkerboard pattern constrained stochastic screen pattern corresponding to a specific gray level that is darker than the first gray level and is lighter than a second gray level, the second gray level being darker than the first gray level, each subsequent first checkerboard pattern constrained stochastic screen pattern maintaining an arrangement of black pixels of the first initial checkerboard pattern constrained stochastic screen pattern, each subsequent first checkerboard pattern constrained stochastic screen pattern including a number of additional black pixels such that a total number of black pixels in a subsequent first checkerboard pattern constrained stochastic screen pattern is greater than a number of black pixels in the initial checkerboard pattern constrained stochastic screen pattern, each additional black pixel in the subsequent first checkerboard pattern constrained stochastic screen patterns being positioned in the subsequent first checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern (see, for example, paragraph **[0036]** of the published patent application); generates a second checkerboard pattern constrained stochastic screen pattern, the second checkerboard pattern constrained stochastic screen pattern corresponding to the second gray level, the second checkerboard pattern constrained stochastic screen pattern maintaining the arrangement of black pixels of the first initial checkerboard pattern constrained stochastic screen pattern, the second checkerboard

pattern constrained stochastic screen pattern including a number of additional black pixels such that a total number of black pixels in the second checkerboard pattern constrained stochastic screen pattern is greater than a number of black pixels in the initial checkerboard pattern constrained stochastic screen pattern, each additional black pixel in the second checkerboard pattern constrained stochastic screen patterns being positioned in the second checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern (see, for example, paragraph **[0039]** of the published patent application); and generates a plurality of subsequent second checkerboard pattern constrained stochastic screen patterns, each subsequent second checkerboard pattern constrained stochastic screen pattern corresponding to a specific gray level that is darker than the second gray level and is lighter than a third gray level, the third gray level being darker than the second gray level, each subsequent second checkerboard pattern constrained stochastic screen pattern maintaining an arrangement of black pixels of the second checkerboard pattern constrained stochastic screen pattern, each subsequent second checkerboard pattern constrained stochastic screen pattern including a number of additional black pixels such that a total number of blacks in a subsequent second checkerboard pattern constrained stochastic screen pattern is greater than a number of black pixels in the second checkerboard pattern constrained stochastic screen pattern, each additional black pixel in the subsequent second checkerboard pattern constrained stochastic screen patterns being positioned in the subsequent second checkerboard pattern constrained stochastic screen patterns at a pixel position corresponding to a white pixel position in the checkerboard pattern (see, for example, paragraph **[0040]** of the published patent application).

C. Independent Claim 9

Independent claim 9 recites a method for converting a gray scale image received at d levels, for reproduction at c levels, where d > c, the method, in optional sequence, receives the gray scale image including a plurality of pixels; and compares, on a pixel-by-pixel basis, a value of each of the pixels in the gray scale image to a corresponding threshold value in a stochastic screen (see, for example, paragraph **[0022]** of the published patent application), the stochastic screen being constrained by a

checkerboard pattern (see, for example, paragraph **[0023]** of the published patent application), the checkerboard pattern constrained stochastic screen comprising a set of threshold values, each threshold value in the checkerboard pattern constrained stochastic screen corresponding to a gray level, each threshold value corresponding to a gray level between a first gray level (g_{s1}) and a second gray level (g_{s2}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a black pixel position in the checkerboard pattern (see, for example, paragraph **[0036]** of the published patent application), each threshold value corresponding to a gray level between the second gray level (g_{s2}) and a third gray level (g_{s3}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a white pixel position in the checkerboard pattern (see, for example, paragraph **[0039]** of the published patent application), the first gray level (g_{s1}) being greater than the second gray level (g_{s2}), the second gray level (g_{s2}) being greater than the third gray level (g_{s3}, the third gray level (g_{s3}) corresponding to a black dither of 50% or less for gray levels (g_s) wherein $x < g_s < y$, x corresponding to 100% black, y corresponding to 0% black.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A. Rejection under 35 U.S.C. §102(e) over Stanich et al.

The grounds of rejection to be reviewed on appeal are whether claim 6 is patentable over Stanich et al. (US-A-6,597,813) in accordance with 35 U.S.C. §102(e).

B. Rejection under 35 U.S.C. §103 over Stanich et al. in view of Chen et al.

The grounds of rejection to be reviewed on appeal are whether claims 1-5 and 7-15 are patentable over Stanich et al. (US-A-6,597,813) in view of Chen et al. (US-A-4,668,995) in accordance with 35 U.S.C. §103.

VII. ARGUMENTS

A. Rejection under 35 U.S.C. §102(e)

Claim 6 has been rejected under 35 U.S.C. §102(e) as being anticipated by Stanich et al. (US-A-6,597,813). This rejection is respectfully traversed.

In formulating the rejection of claim 6, the Examiner alleges that Stanich et al. discloses, at column 5, line 60 to Column 6, line 16, a screen wherein substantially all the threshold values corresponding to gray levels between g_{s1} and g_{s2} coincide with black positions in a constraining checkerboard pattern. Moreover, the Examiner alleges that Stanich et al. discloses, at column 6, lines 39-43, a screen wherein substantially all the threshold values corresponding to gray levels between g_{s2} and g_{s3} coincide with white positions in the constraining checkerboard pattern.

From these allegations, the Examiner concludes that the teachings of Stanich et al. anticipate the presently claimed invention of independent claim 6. These allegations and conclusion are respectfully traversed.

Independent claim 6 recites a method of generating a halftone screen for converting an image received at d levels, for reproduction at c levels, where d > c, the method, in optional sequence, by generating a first initial stochastic screen pattern for a first gray level, the initial stochastic screen pattern being constrained by a checkerboard pattern such that a black pixel in the first initial checkerboard pattern constrained stochastic screen pattern is positioned in the first initial checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern.

The method of claim 6 also generates a plurality of subsequent first checkerboard pattern constrained stochastic screen patterns, each subsequent first checkerboard pattern constrained stochastic screen pattern corresponding to a specific gray level that is darker than the first gray level and is lighter than a second gray level, the second gray level being darker than the first gray level, each subsequent first checkerboard pattern constrained stochastic screen pattern maintaining an arrangement of black pixels of the first initial checkerboard pattern constrained stochastic screen pattern, each subsequent first checkerboard pattern constrained stochastic screen pattern including a number of additional black pixels such that a total

number of black pixels in a subsequent first checkerboard pattern constrained stochastic screen pattern is greater than a number of black pixels in the initial checkerboard pattern constrained stochastic screen pattern, each additional black pixel in the subsequent first checkerboard pattern constrained stochastic screen patterns being positioned in the subsequent first checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern.

The method of claim 6 further generates a second checkerboard pattern constrained stochastic screen patterns, the second checkerboard pattern constrained stochastic screen pattern corresponding to the second gray level, the second checkerboard pattern constrained stochastic screen pattern maintaining the arrangement of black pixels of the first initial checkerboard pattern constrained stochastic screen pattern, the second checkerboard pattern constrained stochastic screen pattern including a number of additional black pixels such that a total number of black pixels in the second checkerboard pattern constrained stochastic screen pattern is greater than a number of black pixels in the initial checkerboard pattern constrained stochastic screen pattern, each additional black pixel in the second checkerboard pattern constrained stochastic screen patterns being positioned in the second checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern.

The method of claim 6 also generates a plurality of subsequent second checkerboard pattern constrained stochastic screen patterns, each subsequent second checkerboard pattern constrained stochastic screen pattern corresponding to a specific gray level that is darker than the second gray level and is lighter than a third gray level, the third gray level being darker than the second gray level, each subsequent second checkerboard pattern constrained stochastic screen pattern maintaining an arrangement of black pixels of the second checkerboard pattern constrained stochastic screen pattern, each subsequent first checkerboard pattern constrained stochastic screen pattern including a number of additional black pixels such that a total number of blacks in a subsequent second checkerboard pattern constrained stochastic screen pattern is greater than a number of black pixels in the second checkerboard pattern constrained stochastic screen pattern, each additional black pixel in the subsequent

second checkerboard pattern constrained stochastic screen patterns being positioned in the subsequent second checkerboard pattern constrained stochastic screen patterns at a pixel position corresponding to a white pixel position in the checkerboard pattern.

As set forth above, the presently claimed invention of independent claim 6 recites that each additional black pixel in a subsequent first checkerboard pattern constrained stochastic screen pattern corresponding to a gray level between a first gray level (g_{s1}) and a second gray level (g_{s2}) is positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a black pixel position in the checkerboard pattern. Moreover, the presently claimed invention of independent claim 6 recites that each additional black pixel in a subsequent second checkerboard pattern constrained stochastic screen pattern corresponding to a gray level between the second gray level (g_{s2}) and a third gray level (g_{s3}) is positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a white pixel position in the checkerboard pattern.

To better appreciate the screens of presently claimed invention of independent claim 6, Figures A1, B1, C1, and D1 have been provided to conceptually illustrate the locating of the additional black pixels in the claimed checkerboard pattern constrained stochastic screen as a function of the grey level.

Figure A1, as illustrated below, conceptually represents an exemplary stochastic screen having no cluster constraint wherein **T** represents a possible next black pixel location of the screen and **W** represents a non-possible next black pixel location of the screen.

Figure A1

W	W	T	W	W	W	W	W	W
W	W	W	W	T	T	W	T	W
W	T	W	W	W	W	W	W	T
W	W	T	T	W	W	T	W	W
T	T	T	W	T	T	W	T	W
W	W	T	T	T	T	T	W	T
W	W	T	W	T	W	W	T	W
W	T	W	W	W	T	W	T	W
T	W	W	T	T	W	W	W	T

Figure B1, as illustrated below, conceptually represents the exemplary stochastic screen of Figure A1 having a checkerboard pattern constraint applied thereto, wherein **T** represents a possible additional black pixel location of the exemplary stochastic screen of Figure A1, **W** represents a non-possible next black pixel location of the exemplary stochastic screen of Figure A1, CB represents a black pixel location of a checkerboard pattern, and CW represents a white pixel location of a checkerboard pattern.

As illustrated in Figure B1, cells with **T**/CB represent the possible additional black pixel locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}). Cells with **W**/CB represent a non-possible black pixel location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}).

Moreover, as illustrated in Figure B1, cells with **T**/CW represent the possible additional black pixel locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}). Cells with **W**/CW represent a non-possible black pixel location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}).

Figure B1

W/CW	**W**/CB	T/CW	**W**/CB	**W**/CW	**W**/CB	**W**/CW	**W**/CB	**W**/CW
W/CB	**W**/CW	**W**/CB	**W**/CW	T/CB	T/CW	**W**/CB	T/CW	**W**/CB
W/CW	T/CB	**W**/CW	**W**/CB	**W**/CW	**W**/CB	**W**/CW	**W**/CB	T/CW
W/CB	**W**/CW	T/CB	T/CW	**W**/CB	**W**/CW	T/CB	**W**/CW	**W**/CB
T/CW	T/CB	T/CW	**W**/CB	T/CW	T/CB	**W**/CW	T/CB	**W**/CW
W/CB	**W**/CW	T/CB	T/CW	T/CB	T/CW	T/CB	**W**/CW	T/CB
W/CW	**W**/CB	T/CW	**W**/CB	T/CW	**W**/CB	**W**/CW	T/CB	**W**/CW
W/CB	T/CW	**W**/CB	**W**/CW	**W**/CB	T/CW	**W**/CB	T/CW	**W**/CB
T/CW	**W**/CB	**W**/CW	T/CB	T/CW	**W**/CB	**W**/CW	**W**/CB	T/CW

As illustrated in Figure B1, cells with **T**/CB represent the possible additional black pixel locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}). Cells with **W**/CB represent a non-possible black pixel location of the checkerboard

pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}). The regulating of the additional black pixels to a black pixel position in the checkerboard pattern when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}) can be visualized more clearly by Figure C1 wherein the yellow highlighted cells conceptually represent the possible next black pixel locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}).

Figure C1

W/CW	**W**/CB	T/CW	**W**/CB	**W**/CW	**W**/CB	**W**/CW	**W**/CB	**W**/CW
W/CB	**W**/CW	**W**/CB	**W**/CW	T/CB	T/CW	**W**/CB	T/CW	**W**/CB
W/CW	T/CB	**W**/CW	**W**/CB	**W**/CW	**W**/CB	**W**/CW	**W**/CB	T/CW
W/CB	**W**/CW	T/CB	T/CW	**W**/CB	**W**/CW	T/CB	**W**/CW	**W**/CB
T/CW	T/CB	T/CW	**W**/CB	T/CW	T/CB	**W**/CW	T/CB	**W**/CW
W/CB	**W**/CW	T/CB	T/CW	T/CB	T/CW	T/CB	**W**/CW	T/CB
W/CW	**W**/CB	T/CW	**W**/CB	T/CW	**W**/CB	**W**/CW	T/CB	**W**/CW
W/CB	T/CW	**W**/CB	**W**/CW	**W**/CB	T/CW	**W**/CB	T/CW	**W**/CB
T/CW	**W**/CB	**W**/CW	T/CB	T/CW	**W**/CB	**W**/CW	**W**/CB	T/CW

Moreover, as illustrated in Figure B1, cells with T/CW represent the possible additional black pixel locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}). Cells with **W**/CW represent a non-possible black pixel location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}). The regulating of the additional black pixels to a white pixel position in the checkerboard pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) can be visualized more clearly by Figure D1 wherein the green highlighted cells conceptually represent the possible additional black pixel locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}).

Figure D1

W/CW	W/CB	T/CW	W/CB	W/CW	W/CB	W/CW	W/CB	W/CW
W/CB	W/CW	W/CB	W/CW	T/CB	T/CW	W/CB	T/CW	W/CB
W/CW	T/CB	W/CW	W/CB	W/CW	W/CB	W/CW	W/CB	T/CW
W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	T/CB	W/CW	W/CB
T/CW	T/CB	T/CW	W/CB	T/CW	T/CB	W/CW	T/CB	W/CW
W/CB	W/CW	T/CB	T/CW	T/CB	T/CW	T/CB	W/CW	T/CB
W/CW	W/CB	T/CW	W/CB	T/CW	W/CB	W/CW	T/CB	W/CW
W/CB	T/CW	W/CB	W/CW	W/CB	T/CW	W/CB	T/CW	W/CB
T/CW	W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	W/CB	T/CW

As conceptualized above visually in Figure C1, the presently claimed invention, as recited by independent claim 6, generates a first checkerboard pattern constrained stochastic screen pattern when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}) wherein the locations of the additional black pixels are positioned in the first checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern.

Furthermore, as conceptualized above visually in Figure D1, the presently claimed invention, as recited by independent claim 6, generates a second checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the additional black pixels are positioned in the second checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern.

As demonstrated, the presently claimed invention, as recited by independent claim 6, provides two distinct methods for locating the additional black pixels wherein the method for locating the additional black pixels is grey level dependent.

In contrast, Stanich et al. teaches, as recognized by the Examiner, a clustered pattern or non-clustered pattern. In other words, Stanich et al. teaches that if a cluster criterion is asserted, the next black pixel must be adjacent to the pixel in question ($\mathbf{P_i}$).

Moreover, the Examiner asserts that Stanich et al., at column 6, lines 39-43, teaches a second checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the additional black pixels are positioned in the second checkerboard

pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern. Contrary to the Examiner's assertion, column 6, lines 39-43, of Stanich et al. fails to teach a second checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the additional black pixels are positioned in the second checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern.

More specifically, column 6, lines 39-43, of Stanich et al. states:

> A test is made in decision block **46** to determine if the iteration count C_1 is larger than some predetermined maximum. If so, the algorithm jumps to function block **47**. Otherwise, the algorithm jumps back to function block **42** to start another iteration. In function block **47**, the repeat count C_2 is increased. [Emphasis in original.]

Column 6, lines 39-43, of Stanich et al. teaches the iteration limits for generating of a screen, not the locating of the additional black pixels at a pixel position in the second checkerboard pattern constrained stochastic screen pattern corresponding to a white pixel position in the checkerboard pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}), as set forth by independent claim 6.

Therefore, Stanich et al. fails to anticipate a second checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the additional black pixels are positioned in the second checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern, as set forth by independent claim 6.

Accordingly, in view of the remarks set forth above, the Examiner is respectfully requested to reconsider and withdraw the rejection under 35 U.S.C. §102(e).

B. Rejection under 35 U.S.C. §103

Claims 1-5 and 7-15 have been rejected under 35 U.S.C. §103 as being unpatentable over Stanich et al. (US-A-6,597,813) in view of Chen et al. (US-A-4,668,995). This rejection is respectfully traversed.

In formulating the rejection of claims 1-5 and 7-15, the Examiner alleges that Stanich et al. discloses, at column 5, line 60 to Column 6, line 16, a screen wherein substantially all the threshold values corresponding to gray levels between g_{s1} and g_{s2} coincide with black positions in a constraining checkerboard pattern. Moreover, the Examiner alleges that Stanich et al. discloses, at column 6, lines 39-43, a screen wherein substantially all the threshold values corresponding to gray levels between g_{s2} and g_{s3} coincide with white positions in the constraining checkerboard pattern.

Moreover, the Examiner recognizes that Stanich et al. fails to disclose $g_{s1} \geq g_{s2} \geq g_{s3}$ and wherein the gray level g_{s3} corresponds to a black dither of 50% or less for gray levels $0 < g_s < 2^m$, wherein $g_s = 0$ corresponds to 100% black and $g_s = 2^m$ corresponds to 0% black. To meet this deficiency in the teachings of Stanich et al., the Examiner proposes to modify the teachings of Stanich et al. with the teachings of Chen et al. The Examiner alleges that Chen et al. teaches $g_{s1} \geq g_{s2} \geq g_{s3}$ and wherein the gray level g_{s3} corresponds to a black dither of 50% or less for gray levels $0 < g_s < 2^m$, wherein $g_s = 0$ corresponds to 100% black and $g_s = 2^m$ corresponds to 0% black.

From these allegations the Examiner concludes that an ordinary skilled artisan would find the presently claim invention obvious in view of the teachings of Stanich et al. and Chen et al. These allegations and conclusion, in view of the amendments set forth above, are respectfully traversed.

1. Independent claim 1

Independent claim 1 recites a halftone processor for converting a gray scale image comprising a plurality of m-bit pixels to a halftoned image comprising a plurality of n-bit pixel images, where m > n, wherein the processor includes a memory storing a stochastic screen, the stochastic mask being a stochastic screen constrained by a checkerboard pattern, the checkerboard pattern constrained stochastic screen

comprising a set of threshold values, each threshold value in the checkerboard pattern constrained stochastic screen corresponding to a gray level, each threshold value corresponding to a gray level between a first gray level (g_{s1}) and a second gray level (g_{s2}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a black pixel position in the checkerboard pattern, each threshold value corresponding to a gray level between the second gray level (g_{s2}) and a third gray level (g_{s3}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a white pixel position in the checkerboard pattern, the first gray level (g_{s1}) being greater than the second gray level (g_{s2}), the second gray level (g_{s2}) being greater than the third gray level (g_{s3}), the third gray level (g_{s3}) corresponding to a black dither of 50% or less for gray levels (g_s) wherein $x < g_s < y$, x corresponding to 100% black, y corresponding to 0% black; and a comparator receiving the gray scale image and the set of threshold values corresponding to the checkerboard pattern constrained stochastic screen, the comparator comparing, on a pixel-by-pixel basis, a value of each pixel in the gray scale image to a corresponding threshold value in the checkerboard pattern constrained stochastic screen to produce the halftoned image.

As set forth above, the presently claimed invention of independent claim 1 recites that each threshold value in a checkerboard pattern constrained stochastic screen pattern corresponding to a gray level between a first gray level (g_{s1}) and a second gray level (g_{s2}) is positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a black pixel position in the checkerboard pattern. Moreover, the presently claimed invention of independent claim 1 recites that each threshold value in a checkerboard pattern constrained stochastic screen pattern corresponding to a gray level between the second gray level (g_{s2}) and a third gray level (g_{s3}) is positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a white pixel position in the checkerboard pattern.

To better appreciate the screens of presently claimed invention of independent claim 1, Figures A2, B2, C2, and D2 have been provided to conceptually illustrate the locating of the threshold values in the claimed checkerboard pattern constrained stochastic screen as a function of the grey level.

Figure A2, as illustrated below, conceptually represents an exemplary stochastic screen having no cluster constraint wherein **T** represents a possible threshold value location of the screen and **W** represents a non-possible threshold value location of the screen.

Figure A2

W	W	T	W	W	W	W	W	W
W	W	W	W	T	T	W	T	W
W	T	W	W	W	W	W	W	T
W	W	T	T	W	W	T	W	W
T	T	T	W	T	T	W	T	W
W	W	T	T	T	T	T	W	T
W	W	T	W	T	W	W	T	W
W	T	W	W	W	T	W	T	W
T	W	W	T	T	W	W	W	T

Figure B2, as illustrated below, conceptually represents the exemplary stochastic screen of Figure A2 having a checkerboard pattern constraint applied thereto, wherein **T** represents a possible threshold value location of the exemplary stochastic screen of Figure A2, **W** represents a non-possible threshold value location of the exemplary stochastic screen of Figure A2, CB represents a black pixel location of a checkerboard pattern, and CW represents a white pixel location of a checkerboard pattern.

As illustrated in Figure B2, cells with **T**/CB represent a possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}). Cells with **W**/CB represent a non-possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}).

Moreover, as illustrated in Figure B2, cells with **T**/CW represent a possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}). Cells with **W**/CW represent a non-possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}).

Figure B2

W/CW	W/CB	T/CW	W/CB	W/CW	W/CB	W/CW	W/CB	W/CW
W/CB	W/CW	W/CB	W/CW	T/CB	T/CW	W/CB	T/CW	W/CB
W/CW	T/CB	W/CW	W/CB	W/CW	W/CB	W/CW	W/CB	T/CW
W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	T/CB	W/CW	W/CB
T/CW	T/CB	T/CW	W/CB	T/CW	T/CB	W/CW	T/CB	W/CW
W/CB	W/CW	T/CB	T/CW	T/CB	T/CW	T/CB	W/CW	T/CB
W/CW	W/CB	T/CW	W/CB	T/CW	W/CB	W/CW	T/CB	W/CW
W/CB	T/CW	W/CB	W/CW	W/CB	T/CW	W/CB	T/CW	W/CB
T/CW	W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	W/CB	T/CW

As illustrated in Figure B2, cells with **T/CB** represent the possible threshold value locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}). Cells with **W/CB** represent a non-possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}). The regulating of the threshold values to a black pixel position in the checkerboard pattern when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}) can be visualized more clearly by Figure C2 wherein the yellow highlighted cells conceptually represent the possible threshold value locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}).

Figure C2

W/CW	W/CB	T/CW	W/CB	W/CW	W/CB	W/CW	W/CB	W/CW
W/CB	W/CW	W/CB	W/CW	T/CB	T/CW	W/CB	T/CW	W/CB
W/CW	T/CB	W/CW	W/CB	W/CW	W/CB	W/CW	W/CB	T/CW
W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	T/CB	W/CW	W/CB
T/CW	T/CB	T/CW	W/CB	T/CW	T/CB	W/CW	T/CB	W/CW
W/CB	W/CW	T/CB	T/CW	T/CB	T/CW	T/CB	W/CW	T/CB
W/CW	W/CB	T/CW	W/CB	T/CW	W/CB	W/CW	T/CB	W/CW
W/CB	T/CW	W/CB	W/CW	W/CB	T/CW	W/CB	T/CW	W/CB
T/CW	W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	W/CB	T/CW

Moreover, as illustrated in Figure B2, cells with T/CW represent the possible threshold value locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}). Cells with **W**/CW represent a non-possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}). The regulating of the threshold values to a white pixel position in the checkerboard pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) can be visualized more clearly by Figure D2 wherein the green highlighted cells conceptually represent the possible threshold value locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}).

Figure D2

W/CW	W/CB	T/CW	W/CB	W/CW	W/CB	W/CW	W/CB	W/CW
W/CB	W/CW	W/CB	W/CW	T/CB	T/CW	W/CB	T/CW	W/CB
W/CW	T/CB	W/CW	W/CB	W/CW	W/CB	W/CW	W/CB	T/CW
W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	T/CB	W/CW	W/CB
T/CW	T/CB	T/CW	W/CB	T/CW	T/CB	W/CW	T/CB	W/CW
W/CB	W/CW	T/CB	T/CW	T/CB	T/CW	T/CB	W/CW	T/CB
W/CW	W/CB	T/CW	W/CB	T/CW	W/CB	W/CW	T/CB	W/CW
W/CB	T/CW	W/CB	W/CW	W/CB	T/CW	W/CB	T/CW	W/CB
T/CW	W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	W/CB	T/CW

As conceptualized above visually in Figure C2, the presently claimed invention, as recited by independent claim 1, generates a checkerboard pattern constrained stochastic screen pattern when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern.

Furthermore, as conceptualized above visually in Figure D2, the presently claimed invention, as recited by independent claim 1, generates a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are

positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern.

As demonstrated, the presently claimed invention, as recited by independent claim 1, provides two distinct methods for locating the threshold values wherein the method for locating the threshold values is grey level dependent.

In contrast, Stanich et al. teaches, as recognized by the Examiner, a clustered pattern or non-clustered pattern. In other words, Stanich et al. teaches that if a cluster criterion is asserted, the next black pixel must be adjacent to the pixel in question ($\mathbf{P_1}$).

Moreover, the Examiner asserts that Stanich et al., at column 6, lines 39-43, teaches a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern. Contrary to the Examiner's assertion, column 6, lines 39-43, of Stanich et al. fails to teach a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern.

More specifically, column 6, lines 39-43, of Stanich et al. states:

> A test is made in decision block **46** to determine if the iteration count C_1 is larger than some predetermined maximum. If so, the algorithm jumps to function block **47**. Otherwise, the algorithm jumps back to function block **42** to start another iteration. In function block **47**, the repeat count C_2 is increased. [Emphasis in original.]

Column 6, lines 39-43, of Stanich et al. teaches the iteration limits for generating of a screen, not the locating of the threshold values at a pixel position in the checkerboard pattern constrained stochastic screen pattern corresponding to a white pixel position in the checkerboard pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}), as set forth by independent claim 1.

Therefore, Stanich et al. fails to teach or suggest a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray

level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern, as set forth by independent claim 1.

With respect to Chen et al., Chen et al. fails to teach or suggest a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern, as set forth by independent claim 1.

Therefore, since both Stanich et al. and Chen et al., singly, fail to disclose or suggest a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern, the combination of Stanich et al. and Chen et al. fails to disclose or suggest a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern, as set forth by independent claim 1.

2. Independent claim 9

Independent claim 9 recites a method for converting a gray scale image received at d levels, for reproduction at c levels, where d > c, the method, in optional sequence, by receiving the gray scale image including a plurality of pixels and comparing, on a pixel-by-pixel basis, a value of each of the pixels in the gray scale image to a corresponding threshold value in a stochastic screen, the stochastic screen being constrained by a checkerboard pattern, the checkerboard pattern constrained stochastic screen comprising a set of threshold values, each threshold value in the checkerboard pattern constrained stochastic screen corresponding to a gray level, each threshold value corresponding to a gray level between a first gray level (g_{s1}) and a second gray

level (g_{s2}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a black pixel position in the checkerboard pattern, each threshold value corresponding to a gray level between the second gray level (g_{s2}) and a third gray level (g_{s3}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a white pixel position in the checkerboard pattern, the first gray level (g_{s1}) being greater than the second gray level (g_{s2}), the second gray level (g_{s2}) being greater than the third gray level (g_{s3}, the third gray level (g_{s3}) corresponding to a black dither of 50% or less for gray levels (g_s) wherein $x < g_s < y$, x corresponding to 100% black, y corresponding to 0% black.

As set forth above, the presently claimed invention of independent claim 9 recites that each threshold value in a checkerboard pattern constrained stochastic screen pattern corresponding to a gray level between a first gray level (g_{s1}) and a second gray level (g_{s2}) is positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a black pixel position in the checkerboard pattern. Moreover, the presently claimed invention of independent claim 9 recites that each threshold value in a checkerboard pattern constrained stochastic screen pattern corresponding to a gray level between the second gray level (g_{s2}) and a third gray level (g_{s3}) is positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a white pixel position in the checkerboard pattern.

To better appreciate the screens of presently claimed invention of independent claim 9, Figures A3, B3, C3, and D3 have been provided to conceptually illustrate the locating of the threshold values in the claimed checkerboard pattern constrained stochastic screen as a function of the grey level.

Figure A3, as illustrated below, conceptually represents an exemplary stochastic screen having no cluster constraint wherein **T** represents a possible threshold value location of the screen and **W** represents a non-possible threshold value location of the screen.

Figure A3

W	W	T	W	W	W	W	W	W
W	W	W	W	T	T	W	T	W
W	T	W	W	W	W	W	W	T
W	W	T	T	W	W	T	W	W
T	T	T	W	T	T	W	T	W
W	W	T	T	T	T	T	W	T
W	W	T	W	T	W	W	T	W
W	T	W	W	W	T	W	T	W
T	W	W	T	T	W	W	W	T

Figure B3, as illustrated below, conceptually represents the exemplary stochastic screen of Figure A3 having a checkerboard pattern constraint applied thereto, wherein **T** represents a possible threshold value location of the exemplary stochastic screen of Figure A3, **W** represents a non-possible threshold value location of the exemplary stochastic screen of Figure A3, CB represents a black pixel location of a checkerboard pattern, and CW represents a white pixel location of a checkerboard pattern.

As illustrated in Figure B3, cells with **T**/CB represent a possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}). Cells with **W**/CB represent a non-possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}).

Moreover, as illustrated in Figure B3, cells with **T**/CW represent a possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}). Cells with **W**/CW represent a non-possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}).

Figure B3

W/CW	W/CB	T/CW	W/CB	W/CW	W/CB	W/CW	W/CB	W/CW
W/CB	W/CW	W/CB	W/CW	T/CB	T/CW	W/CB	T/CW	W/CB
W/CW	T/CB	W/CW	W/CB	W/CW	W/CB	W/CW	W/CB	T/CW
W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	T/CB	W/CW	W/CB
T/CW	T/CB	T/CW	W/CB	T/CW	T/CB	W/CW	T/CB	W/CW
W/CB	W/CW	T/CB	T/CW	T/CB	T/CW	T/CB	W/CW	T/CB
W/CW	W/CB	T/CW	W/CB	T/CW	W/CB	W/CW	T/CB	W/CW
W/CB	T/CW	W/CB	W/CW	W/CB	T/CW	W/CB	T/CW	W/CB
T/CW	W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	W/CB	T/CW

As illustrated in Figure B3, cells with **T/**CB represent the possible threshold value locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}). Cells with **W/**CB represent a non-possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}). The regulating of the threshold values to a black pixel position in the checkerboard pattern when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}) can be visualized more clearly by Figure C3 wherein the yellow highlighted cells conceptually represent the possible threshold value locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}).

Figure C3

W/CW	W/CB	T/CW	W/CB	W/CW	W/CB	W/CW	W/CB	W/CW
W/CB	W/CW	W/CB	W/CW	T/CB	T/CW	W/CB	T/CW	W/CB
W/CW	T/CB	W/CW	W/CB	W/CW	W/CB	W/CW	W/CB	T/CW
W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	T/CB	W/CW	W/CB
T/CW	T/CB	T/CW	W/CB	T/CW	T/CB	W/CW	T/CB	W/CW
W/CB	W/CW	T/CB	T/CW	T/CB	T/CW	T/CB	W/CW	T/CB
W/CW	W/CB	T/CW	W/CB	T/CW	W/CB	W/CW	T/CB	W/CW
W/CB	T/CW	W/CB	W/CW	W/CB	T/CW	W/CB	T/CW	W/CB
T/CW	W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	W/CB	T/CW

Moreover, as illustrated in Figure B3, cells with T/CW represent the possible threshold value locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}). Cells with **W**/CW represent a non-possible threshold value location of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}). The regulating of the threshold values to a white pixel position in the checkerboard pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) can be visualized more clearly by Figure D3 wherein the green highlighted cells conceptually represent the possible threshold value locations of the checkerboard pattern constrained exemplary stochastic screen when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}).

Figure D3

W/CW	W/CB	T/CW	W/CB	W/CW	W/CB	W/CW	W/CB	W/CW
W/CB	W/CW	W/CB	W/CW	T/CB	T/CW	W/CB	T/CW	W/CB
W/CW	T/CB	W/CW	W/CB	W/CW	W/CB	W/CW	W/CB	T/CW
W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	T/CB	W/CW	W/CB
T/CW	T/CB	T/CW	W/CB	T/CW	T/CB	W/CW	T/CB	W/CW
W/CB	W/CW	T/CB	T/CW	T/CB	T/CW	T/CB	W/CW	T/CB
W/CW	W/CB	T/CW	W/CB	T/CW	W/CB	W/CW	T/CB	W/CW
W/CB	T/CW	W/CB	W/CW	W/CB	T/CW	W/CB	T/CW	W/CB
T/CW	W/CB	W/CW	T/CB	T/CW	W/CB	W/CW	W/CB	T/CW

As conceptualized above visually in Figure C3, the presently claimed invention, as recited by independent claim 9, generates a checkerboard pattern constrained stochastic screen pattern when the grey level is between a first gray level (g_{s1}) and a second gray level (g_{s2}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern.

Furthermore, as conceptualized above visually in Figure D3, the presently claimed invention, as recited by independent claim 9, generates a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are

positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern.

As demonstrated, the presently claimed invention, as recited by independent claim 9, provides two distinct methods for locating the threshold values wherein the method for locating the threshold values is grey level dependent.

In contrast, Stanich et al. teaches, as recognized by the Examiner, a clustered pattern or non-clustered pattern. In other words, Stanich et al. teaches that if a cluster criterion is asserted, the next black pixel must be adjacent to the pixel in question ($\mathbf{P_1}$).

Moreover, the Examiner asserts that Stanich et al., at column 6, lines 39-43, teaches a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern. Contrary to the Examiner's assertion, column 6, lines 39-43, of Stanich et al. fails to teach a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern.

More specifically, column 6, lines 39-43, of Stanich et al. states:

> A test is made in decision block **46** to determine if the iteration count C_1 is larger than some predetermined maximum. If so, the algorithm jumps to function block **47**. Otherwise, the algorithm jumps back to function block **42** to start another iteration. In function block **47**, the repeat count C_2 is increased. [Emphasis in original.]

Column 6, lines 39-43, of Stanich et al. teaches the iteration limits for generating of a screen, not the locating of the threshold values at a pixel position in the checkerboard pattern constrained stochastic screen pattern corresponding to a white pixel position in the checkerboard pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}), as set forth by independent claim 9.

Therefore, Stanich et al. fails to teach or suggest a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray

level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern, as set forth by independent claim 9.

With respect to Chen et al., Chen et al. fails to teach or suggest a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern, as set forth by independent claim 9.

Therefore, since both Stanich et al. and Chen et al., singly, fail to disclose or suggest a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern, the combination of Stanich et al. and Chen et al. fails to disclose or suggest a checkerboard pattern constrained stochastic screen pattern when the grey level is between a second gray level (g_{s2}) and a third gray level (g_{s3}) wherein the locations of the threshold values are positioned in the checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a white pixel position in the checkerboard pattern, as set forth by independent claim 9.

Accordingly, for all the reasons set forth above, the Honorable Board is respectfully requested to reverse all the outstanding rejections. Also, an early indication of allowability is earnestly solicited.

Respectfully submitted,

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MJN/mjn

VIII. CLAIMS APPENDIX

1. A halftone processor for converting a gray scale image comprising a plurality of m-bit pixels to a halftoned image comprising a plurality of n-bit pixel images, where m > n, the processor comprising:

a memory storing a stochastic screen, the stochastic mask being a stochastic screen constrained by a checkerboard pattern, the checkerboard pattern constrained stochastic screen comprising a set of threshold values, each threshold value in the checkerboard pattern constrained stochastic screen corresponding to a gray level, each threshold value corresponding to a gray level between a first gray level (g_{s1}) and a second gray level (g_{s2}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a black pixel position in the checkerboard pattern, each threshold value corresponding to a gray level between the second gray level (g_{s2}) and a third gray level (g_{s3}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a white pixel position in the checkerboard pattern, the first gray level (g_{s1}) being greater than the second gray level (g_{s2}), the second gray level (g_{s2}) being greater than the third gray level (g_{s3}), the third gray level (g_{s3}) corresponding to a black dither of 50% or less for gray levels (g_s) wherein $x < g_s < y$, x corresponding to 100% black, y corresponding to 0% black; and

a comparator receiving the gray scale image and the set of threshold values corresponding to the checkerboard pattern constrained stochastic screen, the comparator comparing, on a pixel-by-pixel basis, a value of each pixel in the gray scale image to a corresponding threshold value in the checkerboard pattern constrained stochastic screen to produce the halftoned image.

2. The processor of claim 1, wherein the halftoned image comprises a plurality of 1-bit pixels.

3. The processor of claim 1, wherein the first gray level (g_{s1}) corresponds to approximately a 5% black dither and the second gray level (g_{s2}) corresponds to approximately a 40% black dither.

4. The processor of claim 1, wherein the second gray level (g_{s2}) corresponds to approximately a 40% black dither and the third gray level (g_{s3}) corresponds to approximately a 50% black dither.

5. The processor of claim 1, wherein the first gray level (g_{s1}) corresponds to approximately a 5% black dither, the second gray level (g_{s2}) corresponds to approximately a 40% black dither and the third gray level (g_{s3}) corresponds to approximately a 50% black dither.

6. A method of generating a halftone screen for converting an image received at d levels, for reproduction at c levels, where d > c, the method, in optional sequence, including:

generating a first initial stochastic screen pattern for a first gray level, the initial stochastic screen pattern being constrained by a checkerboard pattern such that a black pixel in the first initial checkerboard pattern constrained stochastic screen pattern is positioned in the first initial checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern;

generating a plurality of subsequent first checkerboard pattern constrained stochastic screen patterns, each subsequent first checkerboard pattern constrained stochastic screen pattern corresponding to a specific gray level that is darker than the first gray level and is lighter than a second gray level, the second gray level being darker than the first gray level, each subsequent first checkerboard pattern constrained stochastic screen pattern maintaining an arrangement of black pixels of the first initial checkerboard pattern constrained stochastic screen pattern, each subsequent first checkerboard pattern constrained stochastic screen pattern including a number of additional black pixels such that a total number of black pixels in a subsequent first checkerboard pattern constrained stochastic screen pattern is greater than a number of black pixels in the initial checkerboard pattern constrained stochastic screen pattern, each additional black pixel in the subsequent first checkerboard pattern constrained stochastic screen patterns being positioned in the subsequent first checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern;

generating a second checkerboard pattern constrained stochastic screen pattern, the second checkerboard pattern constrained stochastic screen pattern corresponding to the second gray level, the second checkerboard pattern constrained stochastic screen pattern maintaining the arrangement of black pixels of the first initial checkerboard pattern constrained stochastic screen pattern, the second checkerboard pattern constrained stochastic screen pattern including a number of additional black pixels such that a total number of black pixels in the second checkerboard pattern constrained stochastic screen pattern is greater than a number of black pixels in the initial checkerboard pattern constrained stochastic screen pattern, each additional black pixel in the second checkerboard pattern constrained stochastic screen patterns being positioned in the second checkerboard pattern constrained stochastic screen pattern at a pixel position corresponding to a black pixel position in the checkerboard pattern; and

generating a plurality of subsequent second checkerboard pattern constrained stochastic screen patterns, each subsequent second checkerboard pattern constrained stochastic screen pattern corresponding to a specific gray level that is darker than the second gray level and is lighter than a third gray level, the third gray level being darker than the second gray level, each subsequent second checkerboard pattern constrained stochastic screen pattern maintaining an arrangement of black pixels of the second checkerboard pattern constrained stochastic screen pattern, each subsequent second checkerboard pattern constrained stochastic screen pattern including a number of additional black pixels such that a total number of blacks in a subsequent second checkerboard pattern constrained stochastic screen pattern is greater than a number of black pixels in the second checkerboard pattern constrained stochastic screen pattern, each additional black pixel in the subsequent second checkerboard pattern constrained

stochastic screen patterns being positioned in the subsequent second checkerboard pattern constrained stochastic screen patterns at a pixel position corresponding to a white pixel position in the checkerboard pattern.

7. The method of claim 6, wherein the first gray level corresponds to approximately a 5% black dither and the second gray level corresponds to approximately a 40% black dither.

8. The method of claim 6, wherein the second gray level corresponds to approximately a 40% black dither and the third gray level corresponds to approximately a 50% black dither.

9. A method for converting a gray scale image received at d levels, for reproduction at c levels, where d > c, the method, in optional sequence, including:

receiving the gray scale image including a plurality of pixels; and

comparing, on a pixel-by-pixel basis, a value of each of the pixels in the gray scale image to a corresponding threshold value in a stochastic screen, the stochastic screen being constrained by a checkerboard pattern, the checkerboard pattern constrained stochastic screen comprising a set of threshold values, each threshold value in the checkerboard pattern constrained stochastic screen corresponding to a gray level, each threshold value corresponding to a gray level between a first gray level (g_{s1}) and a second gray level (g_{s2}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a black pixel position in the checkerboard pattern, each threshold value corresponding to a gray level

between the second gray level (g_{s2}) and a third gray level (g_{s3}) being positioned in the checkerboard pattern constrained stochastic screen at a pixel position corresponding to a white pixel position in the checkerboard pattern, the first gray level (g_{s1}) being greater than the second gray level (g_{s2}), the second gray level (g_{s2}) being greater than the third gray level (g_{s3}, the third gray level (g_{s3}) corresponding to a black dither of 50% or less for gray levels (g_s) wherein $x < g_s < y$, x corresponding to 100% black, y corresponding to 0% black.

10. The method of claim 9, wherein the first gray level (g_{s1}) corresponds to approximately a 5% black dither and the second gray level (g_{s2}) corresponds to approximately a 40% black dither.

11. The processor of claim 9, wherein the second gray level (g_{s2}) corresponds to approximately a 40% black dither and the third gray level (g_{s3}) corresponds to approximately a 50% black dither.

12. The processor of claim 9, wherein the second gray level (g_{s2}) corresponds to approximately a 40% black dither.

13. The processor of claim 9, wherein the first gray level (g_{s1}) corresponds to black dither of less than 15%.

14. The processor of claim 1, wherein the second gray level (g_{s2}) corresponds to approximately a 40% black dither.

15. The processor of claim 1, wherein the first gray level (g_{s1}) corresponds to black dither of less than 15%.

IX. EVIDENCE APPENDIX

NONE

X. RELATED PROCEEDINGS APPENDIX

NONE